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BEHIND ACQUISITIONS OF ALLIANCE PARTNERS: EXPLORATORY LEARNING AND NETWORK EMBEDDEDNESS

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Acquisition research has traditionally been dominated by economic and atomistic assumptions. This study extends acquisition research by integrating behavioral learning and social network perspectives to examine the acquisitions of alliance partners. Specifically, we examine, at the dyadic level, how firms' alliance learning approaches (exploration versus exploitation) and their joint and relative embeddedness in alliance networks (joint brokerage positions and relative centrality) can interact to drive subsequent acquisitions of alliance partners. Our analyses of the U.S. computer industry support our theoretical framework, highlighting the unique and previously underexplored behavioral and relational drivers of acquisitions.

Alliances and acquisitions are two important organizational activities for accessing external resources (Wang & Zajac, 2007). Although the literature generally treats them as parallel in nature, firms often acquire alliance partners (Folta & Miller, 2002; Porrini, 2004; Zollo & Reuer, 2010). Then, what drives acquisitions of alliance partners? Prior research has primarily relied on economic or financial explanations such as transaction costs, agency conflicts, and real options (Folta & Miller, 2002; Hagedoorn & Sadowski, 1999; Kogut, 1991), and paid relatively little attention to behavioral and network drivers. A stream of recent work has increasingly recognized that firms often draw on behavioral learning to make acquisition decisions (Haleblian, Kim, & Rajagopalan, 2006; Hitt, Harrison, & Ireland, 2001; Levinthal & March, 1993; Vermeulen & Barkema, 2001; Zollo & Reuer, 2010). Another stream of research has suggested that firms are embedded in networks of relationships that can have a strong bearing on acquisitions (Haunschild, 1993; Lin, Peng, Yang, & Sun, 2009; Palmer, Barber, Zhou, & Soysal, 1995; Rangan, 2000; Yang, Sun, Lin, & Peng, 2011). In this article, we extend and bridge these two previously separated streams of research to explore some critical but often underexplored drivers for acquisitions. This approach allows us to consider both alliance attributes and network characteristics (Shipilov, 2006; Tsai, 2001) and link the often segmented literatures on alliances and on acquisitions. Specifically, we ask: How do firms' learning in alliances and embeddedness in their alliance networks drive their subsequent acquisitions of alliance partners?

Two motivations fuel our study. First, firms are behavioral in nature. As "boundedly rational" players, they rely on past experience and accumulated learning to make strategic decisions (Levinthal & March, 1993). Extending prior studies that have typically focused on the role of direct acquisition experience (Haleblian et al., 2006), we examine instead the role of firms' learning from their alliance networks. This is not only because alliances are one of the most dominant and prevalent forms of interfirm relationships in the corporate world, but also because firms' learning approach in alliances reveals their behavioral tendencies for future acquisition decisions. Specifically, we extend the learning spillover argument by differentiating between the nature of learning in an exploration alliance and that in an exploitation alliance (March, 1991; Zollo & Reuer, 2010). Exploration alliances often serve as opportunity-seeking vehicles whereby

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firms experiment with new knowledge, access partners' tacit knowledge, and evaluate the intrinsic value of the knowledge from these sources. In contrast, exploitation alliances generally focus on short-term economic returns from existing knowledge. We argue that experiences gained from exploration alliance are more likely to shape firms' expectations about future acquisitions.

Second, firms are not atomistic players but relational entities subject to opportunities and constraints in their networks (Uzzi, 1996). Such a perspective is particularly relevant to our research question, as acquisitions are fundamentally about interfirm governance choices, which are relational in nature and can be influenced by firms' embeddedness in alliance networks (Lin et al., 2009; Yin & Shanley, 2008). Although firms can rely on alliance learning for subsequent acquisitions, such learning also occurs within alliance networks and is often facilitated by firms' network positions. Thus, it may be better to jointly consider a firm's alliance learning with its network embeddedness, given their close interaction (Tsai, 2001). Some previous studies have hinted at the importance of such a match and proposed that exploratory learning thrives in an open network (a network with low density of connections between contacts), in which brokerage opportunities are abundant (Hansen, Podolny, & Pfeffer, 2001; McFadyen & Cannella, 2004). Others have further contended that relative centrality among alliance firms may translate into asymmetry in negotiation power, resulting in disparate ownership positions in joint ventures (Ahuja, Polidoro, & Mitchell, 2009). Extending such insights to acquisition research, we argue that an integration of alliance learning approaches and network embeddedness is critical for understanding acquisitions of alliance partners.

In sum, we examine acquisitions of alliance partners in terms of interactions between firms' alliance learning and aspects of their joint and relative network embeddedness at the dyadic level, such as "joint brokerage position" and "relative centrality." In doing so, we integrate the relatively isolated literatures on alliances, acquisitions, and learning and thus offer a new explanation that differs from traditional acquisition research, which has typically been dominated by economic or financial explanations and atomistic assumptions (as noted by Brass, Galaskiewicz, Greve, and Tsai [2004] and Parkhe, Wasserman, and Ralston [2006]). Although some previous work has recognized the importance of network embeddedness behind acquisitions, it has emphasized an imitation mechanism acting mostly through interlocking directorate networks (Haunschild, 1993; Palmer et al., 1995). As a point of departure, our theoretical framework originates from firms' learning and network embeddedness in their strategic alliance networks, which are a more pertinent form of interfirm relationships that can influence subsequent acquisitions of partner firms.

ALLIANCE LEARNING, NETWORK EMBEDDEDNESS, AND ACQUISITIONS

Alliances and acquisitions are two important and distinctive means for firms to access external resources (Wang & Zajac, 2007). A fundamental difference is that alliances only allow for *partial* control, while acquisitions afford *complete* ownership control of assets (Yin & Shanley, 2008). They entail different flexibilities and risks: on the one hand, alliances allow piecemeal involvement and continuous reassessment of partners' contribution to a venture; on the other hand, acquisitions demand irreversible financial and managerial commitment from acquiring firms (Balakrishnan & Koza, 1993; Mitsuhashi & Grece, 2009).

Despite their differences, alliances and acquisitions also share some commonalities. First, both are often used to access external resources. Second, they share some common motivations, such as synergy seeking. These overlapping functions indicate that alliances and acquisitions are closely related and that one activity may inform the other (Zollo & Reuer, 2010).

The acquisition literature, however, has been developing largely in parallel with the alliance literature, with relatively little cross-fertilization occurring between the two (Yang, Lin, & Lin, 2010). Although with different emphases and insights, prior theories have predominantly centered on economic rationality and atomistic assumptions, falling short of uncovering the behavioral and relational drivers of acquisitions (Levinthal & March, 1993; Lin et al., 2009). Rather than being atomistic players detached from their unique histories and broad contexts, firms are relational entities within alliance networks (Uzzi, 1996). Consequently, firms' decisions to acquire alliance partners cannot be separated from either their past experiences or their embeddedness in the alliance relationships (Lin et al., 2009; Yang et al., 2011).

We contend that a focus on firms' alliance learning and embeddedness in alliance networks may provide new insights into the conditions under which firms may acquire alliance partners. Specifically, we argue that firms are adaptive learning players. Owing to bounded rationality, firms often are not able to accurately assess the value of target firms. Prior interaction experience with potential targets in alliances offers valuable information on

the valuation of targets. We further point out that the value of learning experiences varies with certain alliance contexts.

Although there are many ways to "dimensionalize" alliance learning, March's (1991) influential exploitation-exploration framework represents an insightful way to deal with alliance heterogeneity. Since Koza and Lewin's (1998) extension of March's (1991) concepts into the alliance literature, researchers have explored the nature and implications of exploration and exploitation alliances (Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004). Specifically, in exploration alliances, partner firms capitalize on their joint capabilities to discover new opportunities, build up new competencies, and adapt to environmental changes. In exploitation alliances, partner firms focus on refinement and efficiency of their existing knowledge and capabilities (March, 1991). We argue that exploration alliances are more dynamic than exploitation alliances and that exploration alliances provide a unique learning experience in which firms can evaluate partners' tacit knowledge and intrinsic value (Dussauge, Garrette, & Mitchell, 2000). Consequently, firms with exploratory alliances tend to have an advantage in leveraging such valuable experiences in acquisitions of alliance partners.

In addition to alliance learning, it has long been argued that acquisitions do not take place in a vacuum, but are embedded in a broader social and economic context (Haunschild, 1993; Lin et al., 2009; Meyer, Estrin, Bhaumik, & Peng, 2009). Rangan (2000) argued that price mechanisms tend to play a determining role in influencing economic actions if institutions governing market mechanisms are better developed. Yet, in many markets—in particular, the market for corporate control (commonly known as the acquisition market)—the institutions governing transactions are not well developed (Chen & Young, 2010; Meyer et al., 2009). Consequently, network embeddedness resulting from such relational factors may be especially strong, calling for a relational perspective on acquisitions (Lin et al., 2009).

We propose that it is important to integrate the behavioral learning perspective and the social network perspective when predicting acquisitions of alliance partners. Although learning through alliances increases firms' *awareness* of partners' value in tacit resources and capabilities, such learning takes place in alliance networks and so is subject to network embeddedness. We further argue that the actual occurrence of partner acquisitions is contingent on firms' *motivation* and *capability*, which are facilitated by how the dyadic relationship between a firm and its partner is embedded in an alliance network. Specifically, we focus on (1) joint brokerage positions and (2) relative centrality, two of the most relevant embeddedness constructs for the study of alliance networks (Gulati & Gargiulo, 1999). Joint brokerage positions refer to the collective network openness (opportunity for brokerage) enjoyed by two firms in an alliance as a whole, and relative centrality denotes the asymmetry in network positions between two alliance partner firms. Joint brokerage position captures the total amount of nonredundant information accessed by an alliance, and relative centrality reflects the degree of distal information search and power dynamics within an alliance. We argue that joint brokerage positions, when coupled with exploration alliances, may increase alliance value and thus firms' motivation to acquire alliance partners. Further, relative centrality may not only help firms in exploration alliances to enhance their ability to access distal information, but also facilitate power imbalance that may lead to the acquisition of partner firms. As most acquisitions are a result of dyadic interactions between two firms, we take a dyadic approach rather than the focal firm approach used by some prior studies (Palmer et al., 1995). These two relational constructs are thus not only representative of key ideas in network research, but also speak directly to the relevance of dyadic interactions between firms in an alliance for subsequent acquisitions.

It should be noted that acquisitions of alliance partners often have rich performance implications. Prior research has suggested that preacquisition alliances can increase postacquisition coordination and build trust between firms (Hagedoorn & Sadowski, 1999). The interorganizational routines developed from alliances can enhance the future interactions between acquiring and target firms (Zollo & Reuer, 2010). Porrini (2004) found that acquisitions of alliance partners ensure target-specific information and experience that help the selection, valuation, and integration of target firms, thus reducing the uncertainty and risks involved for acquirers. This would not be possible for acquisitions of nonpartner firms in the open market. Porrini (2004) further reported that acquisitions of partner firms (firms with prior alliance relationships) correlate positively with postacquisition performance.

Effects of Alliance Learning

Firms' expectations and objectives are often shaped by their experiences, which is also true in the case of partner acquisitions. For two reasons, we argue that, compared with exploitation alli-

ances, exploration alliances are more likely to result in acquisitions of alliance partners. First, exploration alliances provide more relevant foundations for firm risk taking and also better chances for firms to understand partner firms' resources, increasing their awareness of the true value of partner firms. Exploration alliances are designed for knowledge search and creation that extends beyond firms' own knowledge bases. The joint knowledge and capability building in exploration alliances require close interaction that exposes firms to partners' tangible and intangible knowledge. On the contrary, exploitation alliances are mainly used for maximizing the value of existing resources (Levinthal & March, 1993). They have less need for intensive interaction on knowledge creation and transfer (Hansen et al., 2001). For instance, the interaction between alliance firms is much less in a licensing alliance (a form of exploitation alliance) than it is in an R&D alliance (a form of exploration alliance). Thus, compared with exploitation alliances, exploration alliances may enable a better understanding of partners' value as potential targets.

Second, because they involve active search for knowledge and technology, exploration alliances are more dynamic and generate more opportunities for future expansion that can be facilitated by the acquisition of alliance partners. In comparison, exploitation alliances are more stable and focus on maintaining the status quo. In exploration alliances, managers constantly struggle to define responsibilities and benefits of partners, because uncertainty and ambiguity are high (Rothaermel & Deeds, 2004). However, in exploitation alliances, it is relatively easier for managers to define responsibilities and benefits, as the use of existing knowledge and resources entails much less ambiguity (McGrath, 2001). Thus, the stable nature of exploitation alliances may make them less useful for deferred acquisitions (Dussauge et al., 2000). If firms sought to acquire others that are their partners in exploitation alliances, they would be more likely to have done so before they formed the exploitation alliances in the first place. On the contrary, the dynamic and uncertain nature of exploration alliances makes it necessary for firms to understand partners first before initiating acquisition (Kogut, 1991; Tong, Reuer, & Peng, 2008). After managers gain a better understanding of the partners' value as well as the value of new capabilities derived from joint development, firms are more likely to acquire the partners.

Hypothesis 1. Compared with exploitation alliances, exploration alliances are more likely result in acquisitions of alliance partners.

Moderating Roles of Network Embeddedness

Recognizing firms as relational entities embedded in their alliance networks, Hansen and colleagues (2001) and McFadyen and Cannella (2004) suggested that social resources for exploration activities may turn into social liabilities for exploitation activities if the tasks at hand for a firm do not match its network structure. In an acquisition situation, how two partners leverage their relative and joint embeddedness becomes important, as such embeddedness may not only provide cooperation opportunities, but also induce potential power conflicts. Following this line of reasoning, we argue that joint brokerage positions and relative centrality represent two important and relevant dimensions of network embeddedness for moderating the relationship between firms' exploration alliances and subsequent acquisitions of alliance partners.

Joint brokerage positions. The value of the openness or closure of social networks is a critical point of contention between otherwise complementary views of network structures (Burt, 1992; Coleman, 1988). Of the two competing views on the value of network openness, the first one suggests that a closed network—a network of densely interconnected contacts—fosters cohesive ties among network members. Such network closure is expected to not only help the transfer of fine-grained information, but also promote trust, a form of social capital that enhances the development of norms for acceptable behavior and the diffusion of complex information (Coleman, 1988). A second view, on the contrary, is that a closed network is also laden with repetitive and redundant information that may constrain a firm's innovative behaviors. Alternatively, it proposes a different form of social capital that resides in the brokerage opportunities created by the openness (i.e., lack of connection between separate clusters) in a social network (Burt, 1992). It is expected that firms in brokerage positions have the potential to access a broad array of distinct information and referrals that help them anticipate and explore new opportunities (Gulati & Gargiulo, 1999). In this article, we focus on the joint brokerage positions occupied by two firms in an alliance as a whole because the value of an alliance is determined by the pooled contribution of both partners in terms of resources and information.

We argue that when two alliance partners have a high degree of joint brokerage, the access to new and diverse channels through structural holes (disconnections between nonredundant contacts in a network) may provide increasing value for exploration alliances, which thrive on breadth and openness (March, 1991). However, with the increasing

value of exploration alliances in an open network, firms may also face constant renegotiation about the property rights for newly generated technologies that are hard to specify in the beginning of exploration alliances (Rothaermel & Deeds, 2004). Such a dynamic process may further propel firms to acquire alliance partners in two ways. First, the increased value of exploration alliances can alleviate firms' qualms about the true value of partner firms and increase their confidence and motivation regarding internalizing the alliance activities through acquisition (Baum & Ingram, 2003). Second, interpartner conflicts may provide more incentives to initiate acquisition of partner firms, which can resolve these conflicts and also yield more benefits through internalization and hierarchical control (Dussauge et al., 2000). Consequently, with the support of structural hole positions, exploration alliances may become a more rewarding and less risky way for firms to increase their financial commitment and undertake acquisitions of alliance partners (Folta & Miller, 2002).

Conversely, when there is a low degree of joint brokerage, firms tend to be more constrained in their information search, which will primarily be in local and familiar domains. Redundant information flow among network members may undermine the creative activities required by exploration alliances. Because of such a mismatch, these exploration alliances will be unlikely to generate favorable outcomes, and the partners to them may also be less likely to become attractive targets for potential acquisitions. We thus predict that joint brokerage positions strengthen the positive link between exploration alliances and partner acquisitions. Formally,

Hypothesis 2. A high degree of joint brokerage occupied by alliance firms strengthens the positive relationship between exploration alliances and subsequent acquisitions of alliance partners.

Relative centrality. Another important aspect of positional advantage is network centrality (Freeman, 1979). Of the various measures of centrality, we are interested in degree centrality, as our focus is firms' direct partner relationships in their ego networks (Everett & Borgatti, 2005). Since degree centrality is the extent to which a firm occupies a key position with direct ties to other network members, relative centrality is thus the relative difference between two firms' degree centrality. The main effects of degree centrality come from its role in the volume and speed of resource flows as well as its network influence, because network ties are the conduits for assets, information, and status. Compared with peripheral firms, central firms in an alliance network have greater access to various resources in the network and are also likely to receive information more quickly than other network members. In addition, central firms tend to have higher visibility in the network and are likely to have higher status and power than other members (Gnyawali & Madhavan, 2001: 435). However, central firms can also be overly entrenched in their existing relationships and commitments. Such inertia may hinder firms' ability to explore new ideas beyond their familiar domains (Perry-Smith & Shalley, 2003).

We argue that for two reasons, a high level of relative centrality between alliance partners is likely to strengthen the positive link between exploration alliances and acquisitions of alliance partners. First, partners in a peripheral position constitute a valuable complement to central firms in information and resource access. Peripheral firms tend to have access to different information and knowledge that is valuable to central firms (Ahuja et al., 2009). A high level of relative centrality between alliance firms answers the call for distal searches in exploration alliances and motivates central firms to appreciate the unique value of peripheral firms as potential targets. Second, relative centrality often translates into asymmetries in bargaining power and in network influence that give central firms the ability to acquire peripheral partners at relatively low prices (Ahuja et al., 2009; Gnyawali & Madhavan, 2001).

Conversely, when there is a low level of relative centrality (that is, firms have similar levels of centrality in their network), acquisitions of alliance partners may entail more power struggles. In other words, there may be excessive bargaining between acquirers and targets of more or less equal standing (because of their similar centrality) in the alliance network. Such potential challenges may discourage potential acquisitions of alliance partners.

Hypothesis 3. A high level of relative centrality between alliance firms strengthens the positive relationship between exploration alliances and subsequent acquisitions of alliance partners.

METHODS

Sample

Testing our hypotheses required an industry with active acquisitions and alliances. We selected the United States computer industry, including both the software and hardware sectors. Following Rowley and associates (2000), we first constructed the overall industry alliance network using two decision rules: (1) types of relationships between

actors, such as alliances, and (2) attributes of actors, such as membership in an industry sector. We identified firms with at least one strategic alliance with another member of the computer industry. Industry membership was determined by SIC codes: the hardware sector includes 3571, 3572, 3575, and 3577, and the software sector includes 7371, 7372, 7373, and 7374.

Data on alliances and acquisitions were collected from the SDC Platinum database and verified using LexisNexis and the Dow Jones News Retrieval Service. Financial data were retrieved from Compustat, and patent data were collected from the National Bureau of Economic Research (NBER). Overall, we identified 2,852 within-industry alliances announced from 1990 to 1996 (inclusive), involving 1,453 firms. Among them we located 62 focal firms with relatively complete financial information in Compustat and further identified their respective ego networks (an ego network consists of the relationships between a focal firm and its direct partners and the relationships among those direct partners) within the overall industry alliance network. Because SDC does not reveal the termination dates of alliances, and the lifespan of an alliance is usually no more than five years (Kogut, 1988), we used a five-year moving window to capture the cumulative nature of a firm's alliance portfolio. We also did this to capture a firm's network embeddedness—for example, a five-year moving window of the alliance network for 1996 is based on all the newly announced alliances from 1992 to 1996. Consequently, we further collected alliance data from 1986 to 1989, involving an additional 111 alliances. We constructed the symmetric (nondirectional) matrix (1,453 $\times$ 1,453) for each year using Ucinet 6 (Borgatti, Everett, & Freeman, 2002).

Dependent Variable: Acquisitions of Alliance Partners

Our focus is examining whether alliances evolve into acquisitions of alliance partners because of firms' alliance learning and network embeddedness. Thus, we coded our dependent variable as a dummy (1 = "partner acquisition," 0 = "no partner acquisition").

Independent Variables

Exploration alliance index. To construct an exploration alliance index, we analyzed the nature of alliance learning in each alliance. Prior research suggested that alliances involving upstream activities such as R&D that may lead to innovative technologies and applications can be conceptualized as having exploration purposes, whereas alliances involving downstream activities such as the commercialization and utilization of existing technologies are mainly for exploitation (Lin et al., 2009). Therefore, we content-analyzed the description of each alliance (e.g., marketing alliance, licensing alliance) provided in the SDC database. Specifically, we coded those alliances that focused on the discovery and development of new technology as exploration alliances and coded those that focused on marketing and resource utilization as exploitation alliances. For example, as described in SDC Platinum, IBM and Insoft set up an alliance in 1993 to "develop a teleconferencing package for UNIX operating systems. The agreement integrated IBM's AIX Ultimedia Services/6000 with Insoft's Communique software." We coded this alliance as an *exploration* alliance. Similarly, Digital Equipment Corporation and AutoDesk set up an alliance in 1993 to "market Autodesk's AutoCAD Release 2J for Windows computer-aided design software. The software package was to be installed in DEC's desktop PCs." This alliance was coded as an *exploitation* alliance. A combination of both R&D and other agreements was coded as 0.5 exploration and 0.5 exploitation. In addition, given that firms may have different intentions, our coding used the perspective of the focal firm (Lavie & Rosenkopf, 2006).

Joint brokerage positions. The standard way to calculate brokerage position is to rely on Burt's (1992) constraint measure of structural holes, which taps the extent to which a firm's ego network is directly or indirectly concentrated in a single contact. If a firm's alliance partners all have one another as partners, then that firm is highly constrained. A network concentrated in one contact means fewer structural holes. To measure the joint brokerage positions occupied by two firms in an alliance, however, we could not simply sum up their constraint scores, because doing so might neglect the potential network overlap between them. Therefore, for each alliance event we recompiled the network matrices by treating the alliance as a node with two partner firms and used Ucinet 6 to compute the constraint score for this alliance node as the value of joint brokerage positions. Following Soda, Usai, and Zaheer (2004), we multiplied the value of constraint by -1 to capture structural holes (the "opposite" of constraint).

Relative centrality. We first calculated the degree centrality of each firm in the alliances based on the above ego alliance network. We then divided the focal firm's degree centrality by its partner firm's degree centrality to compute the value of relative centrality. A high value indicates that a

focal firm has a higher centrality score than its partner firm.

Control Variables

Equity alliance index. Relative to nonequity alliances, equity alliances may allow a deeper understanding of partner capabilities that may affect subsequent acquisition decisions (Folta & Miller, 2002; Tong et al., 2008). We therefore controlled for equity alliance index (1 = "equity alliance," 0 = "nonequity alliance").

Strategic interdependence. Interdependence among partner firms may affect how one acquires another. Following Gulati (1995) and Rothaermel and Boeker (2008), we used a count of each dyad's nonoverlapping technological niches as a proxy for its strategic interdependence. We first mapped out each firm's patent distribution in the six broad technological categories defined by NBER and then calculated the absolute number of nonoverlapping technological niches between each dyad as a measure of strategic interdependence.

Asymmetry in firm size. If two firms are of equal size, it is difficult for one to acquire the other. We thus divided each focal firm's number of employees by the partner firm's number of employees to compute the asymmetry in firm size.

Combined financial resources. We controlled for the sum of cash held by alliance partner firms before an acquisition, as most acquisitions still rely on cash transactions (Hitt et al., 2001).

Competitor alliance index. If two competing firms form an alliance, there is a high probability that one of them will acquire the other to reduce competition (Yang et al., 2010). We thus created a control variable by comparing alliance partners' business segments as defined by SIC codes. If both firms operated in either the hardware or software sector, we coded competitor alliance index as 1. Otherwise, it was coded as 0.

In addition, we also controlled for industry concentration, measured by the four-firm concentration ratio using data from the U.S. Census Bureau. As these data are only available every five years, we linearly extrapolated the available concentration ratios over missing periods. We also included year dummies to control for unobserved heterogeneity.

Analysis

Since the dependent variable was dichotomous, we ran logistic regression analyses. The presence of multiple observations for a dyad over several years raised the concern of potential interdependence. To address this, we used random-effects logistic models. We also lagged all the independent and control variables by one year in regression and conducted our analyses using the "xtlogit" command in Stata V.10. In other words, if firm A formed five alliances in 1990, it might take some time for firm A to interact with others before initiating acquisitions.

FINDINGS

Table 1 presents descriptive statistics, and Table 2 displays random-effects logistic regression models. Following Aiken and West (1991), we mean-centered the predictor variables before generating interaction terms. To assess the potential threat of collinearity, we estimated the variance inflation factors (VIFs) and found that no variable had a VIF greater than 2.38, which is below the recommended ceiling of 10. We also used the "coldiag" procedure in Stata to conduct the Belsley, Kuh, and Welsch (1980) multicollinearity diagnostic test, which shows that the condition number for our complete model is 7.62, well below the threshold of 30.

TABLE 1
Descriptive Statistics and Correlations[a]

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9
1. Acquisitions of alliance partners	0.01	0.11									
2. Equity alliance index	0.08	0.27	.00								
3. Strategic interdependence	2.35	2.20	−.01	.06							
4. Asymmetry in firm size	50.69	307.42	−.02	.01	−.10						
5. Combined financial resources	143.22	963.64	−.01	−.03	−.02	−.02					
6. Competitor alliance index	0.57	0.49	.07	−.05	−.26	−.01	.03				
7. Industry concentration	39.56	1.96	.02	.03	.09	−.06	.18	.11			
8. Exploration alliance index	0.30	0.38	.03	−.05	−.04	−.03	−.05	−.02	.00		
9. Joint brokerage positions	−0.15	0.24	.03	.03	.34	.05	.06	−.09	.05	.01	
10. Relative centrality	7.98	20.17	.00	.00	.32	.37	−.03	−.02	−.02	−.04	.16

[a] n = 2,838. Correlations above |.06| are significant at the .05 level.

TABLE 2
Results of Random-Effects Logit Models[a]

Variables	Model 1	Model 2	Model 3
Control			
Equity alliance index	−0.21 (−0.20)	−0.54 (−0.46)	−0.53 (−0.45)
Strategic interdependence	0.07 (0.52)	−0.01 (−0.06)	0.05 (0.29)
Asymmetry in firm size	−0.01 (−0.70)	−0.02 (−1.25)	−0.03 (−1.79)
Combined financial resources	−0.00 (−0.24)	−0.00 (−0.18)	−0.00 (−0.15)
Competitor alliance index	1.46 (2.18)*	1.46 (2.11)*	1.37 (1.94)*
Industry concentration	0.00 (0.00)	−0.21 (−0.78)	−0.22 (−0.76)
Predictor			
Exploration alliance index (H1+)		1.63 (2.30)*	3.18 (3.05)**
Joint brokerage positions		25.69 (1.65)†	5.11 (0.55)
Relative centrality		0.04 (2.34)*	−0.02 (−0.45)
Interactive			
Exploration alliance index × joint brokerage positions (H2+)			125.08 (2.44)*
Exploration alliance index × relative centrality (H3+)			0.17 (2.14)*
n	1,155	1,131	1,131
Wald χ^2	8.94	20.60	27.78
Log-likelihood	−69.78	−61.07	−54.96

[a] The dependent variable is partner acquisitions measured at a dyadic level. Year dummy variables are included, but not reported here. Unstandardized coefficients are reported; *z*-values are in parentheses.

† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$

For the random-effects logistic regression models, we first ran the base model with controls only. We then added the predictor variables in model 2 and interaction terms in model 3. Model 1 shows that there is a significant relationship between competitor alliance index and partner acquisition, suggesting that competing firms are likely to acquire alliance partners. In Hypothesis 1, we argue that a firm's exploration alliance index is positively associated with its subsequent acquisitions of alliance partners. The coefficient for exploration alliance index is significant at the .05 level in model 2 and at the .01 level in model 3, supporting our Hypothesis 1. Our Hypothesis 2 argues that joint brokerage positions occupied by alliance firms strengthen the relationship between exploration alliance learning and subsequent acquisitions of alliance partners. The interaction coefficient between joint brokerage positions and exploration alliance index is positive and significant ($p < .05$), supporting Hypothesis 2. Further, the interaction between the exploration alliance index and relative centrality is positively significant ($p < .05$), supporting Hypothesis 3. Figure 1 shows the interaction plots, which are consistent with our predictions. For instance, Panel A illustrates that firms are likely to undertake partner acquisitions when alliance firms share a high degree of joint brokerage.

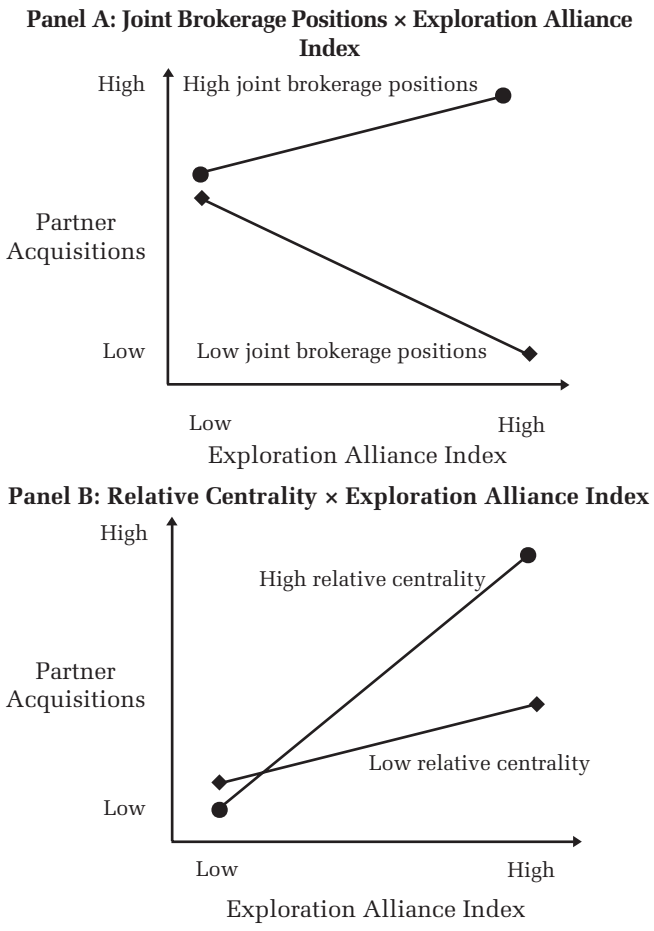
To gain additional insights, we also conducted a separate robustness analysis to examine the performance consequences of a firm's partner acquisitions by regressing a firm's average return on equity (ROE) during the two years following an acquisition of alliance partners. Our findings show that a firm's partner acquisition is positively related to its performance at a significant level ($p < .05$).

DISCUSSION

Contributions

In our view, at least three contributions emerge. First, this study contributes to acquisition research by offering a different explanation, one based on behavioral and relational perspectives that are critical but often underexplored in prior studies. Specifically, we find that firms are behavioral in nature: firms' acquisitions of alliance partners are often informed by the firms' alliance learning approaches. The finding on the role of exploration alliances speaks to the importance of examining the learning nature of alliances if one endeavors to probe the link between alliances and acquisitions. Our study further suggests that firms are relational entities and embedded in interfirm relationships. The nature of alliance learning, when matched

FIGURE 1
Interaction Effects of Alliance Learning and Network Embeddedness



with the right form of network embeddedness, can serve as a good indicator of firms' subsequent acquisition decisions. Thus, behavioral factors (as reflected in alliance learning) and relational factors (as captured by network embeddedness) interact with each other and jointly improve scholarly understanding of overlooked drivers of acquisitions of alliance partners. Our study thus complements existing research on acquisitions by highlighting the previously underexplored behavioral (learning) and relational (network) drivers of partner acquisitions.

Second, this study takes one step forward in bridging two separate streams of research on alliances and on acquisitions. How firms' learning in alliances and the network attributes of alliance relationships drive acquisitions of alliance partners has rarely been examined. This study is thus among the first to leverage the learning spillover argument (Zollo & Reuer, 2010) and suggest that alliance learning affects partner acquisitions in unique ways. Our focus on alliance networks also represents significant progress above and beyond the few previous studies on the link between social networks and acquisitions, which have almost exclusively focused on interlocking directorates (Haunschild, 1993; Palmer et al., 1995).

Finally, this study extends prior social network research by addressing both alliance attributes and network characteristics. Although Granovetter (1985) cautioned against researchers' tendencies toward either "undersocialized" or "oversocialized" approaches, little network research (except Shipilov [2006] and Tsai [2001]) has explicitly examined node characteristics as an important factor in reaping benefits from network positions. Our study highlights the importance of a *match* between a firm's structural position and its learning approach in alliances (Mitsuhashi & Greve, 2009). Firms with exploratory learning in alliances will likely benefit more from an open network through structural hole positions when making acquisition decisions. Also, our findings on relative centrality suggest that firms in exploration alliances are likely to acquire partner firms when there is a large difference in the centrality of their network positions.

Limitations and Future Research Directions

Our results need to be interpreted in light of limitations. In striving for accuracy and simplicity, we only studied one industry in one country, and results should be understood in the context of the U.S. computer industry. Future research can extend this study to other industries and countries to examine the generalizability of our findings. Since we followed prior research to limit the boundaries of our alliance network to be within the computer industry (Rowley et al., 2000), we were thus unable to investigate the impact of cross-industry alliances on acquisitions.

There are several additional avenues for future research. First, to extend our focus on acquisitions of alliance partners, future research could further investigate acquisitions of both partner and nonpartner firms in an industry network. Second, our sample firms are computer firms in the United States, an institutional environment quite different from that in emerging economies such as China (Lin et al., 2009; Peng, 2003). Research on how the institutional differences may differentially affect the relationships among network embeddedness, alliances, and acquisitions is warranted (Chen & Young, 2010; Peng, Sun, Pinkham, & Chen, 2009; Yang et al., 2011). Third, our research only investigated the occurrence of acquisitions by integrating the isolated research on alliances, acquisitions, and learning. It will also be worthwhile to examine

the matches among strategy (exploration and exploitation), network positions, and firm performance. Finally, in our study we focused on the dyadic level to gain an in-depth understanding of partner acquisitions. However, firms often have portfolios of alliances, and a decision on one alliance may influence the decision on another. Future research taking a portfolio-level or cross-level approach may better capture both the overall pattern and the individual characteristics of partner acquisitions.

Conclusion

Although acquisitions have received significant attention, what is not well known is how behavioral and relational factors drive acquisitions of alliance partners. As an initial step in this direction, this article offers an integrative perspective on partner acquisitions and demonstrates that learning approaches and network embeddedness, as embodied in alliance networks, significantly affect acquisitions of partner firms. Firms that approach acquisitions and alliances separately often fail to leverage the learning derived from these sets of related activities and are now increasingly advised to establish a combined "acquisitions and alliances" function (Dyer, Kale, & Singh, 2004). Likewise, scholars interested in acquisitions, alliances, and learning may need to more closely integrate research in these areas. In conclusion, if this article can communicate only one message, we would suggest that bridging the learning and network perspectives appears to be a fruitful and promising avenue for advancing research on the intriguing phenomena of acquisitions, alliances, and learning.

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